Problem B: Meeting the Red Queen

Alice decides to go outside and see the garden before it's too late and she has to go back for dinner. After stepping outside, she has the idea of going to the top of a hill nearby to have a better view of the garden. However, something strange happens; no matter how many times she tries, it seems like she always end up in front of the house's door, the opposite of the way she intended!

In the middle of all this, she stops for a moment in front of a large flower-bed where she has the chance to have a conversation with some of the flowers there, who explain to Alice that "We can talk –when there's anybody worth talking to." They chat for a little while until, suddenly, the Red Queen (one of the pieces of the chess game Alice had at home, now human-sized) appeared on the garden, some distance from Alice and the flowers.

At first, Alice tried to walk towards the Queen through the different paths in the garden, but it did not work as well as she had planned. After some failed attempts, she eventually met with the Queen, but not without first noticing the reason why it wasn't as easy as she had hoped.

Figure 1: Alice meets the Red Queen

The garden is rectangular in shape and Alice can move in four directions: north, south, east and west. However, every time Alice takes a step, the Queen moves one step in the opposite direction –unless her path is blocked by an obstacle, in which case she stands still in her position. For example, every time Alice moves north, the Queen tries to move south, and every time Alice moves east, the Queen tries to move west.

If you know the arrangement of the garden (modelled as a rectangular grid), with its paths and obstacles, and the initial positions of Alice and the Red Queen, can you find out the minimum number of steps required for Alice to meet with the Queen? Alice and the Queen meet if they are on the same square, or if they are on squares that share one side.

Input

Input starts with a positive integer **T**, that denotes the number of test cases ($T \leq 200$).

Each test case starts with a blank line. The next line contains two integers **R** and **C**, which denote the number of rows and columns of the garden.

$1 \leq R, C \leq 16$

R lines follow, each one containing C characters, from the following alternatives:

- A dot (.), representing a free square.

- A number sign (#), representing an obstacle. Neither Alice nor the Queen can move to a square with an obstacle.

- A letter `A`, denoting the initial position for Alice.

- A letter `Q`, denoting the initial position for the Red Queen.

There will be one and only one `A` character and one `Q` character in every test case.

You have to assume that the garden is surrounded by obstacles outside the $R \times C$ squares, so neither Alice nor the Queen can jump out of the grid.

Output

For each test case, print the case number, and then print the minimum number of steps that Alice can take to meet with the Queen. If they can't meet, print **impossible**.

Sample Input

```
3

5 10
......#...
......#.Q.
...#..#...
.A.#......
...#......

3 8
....#...
#####.#.
A.....#Q

4 6
.....Q
####..
..A#..
...#..
```

Output for Sample Input

```
Case 1: 6
Case 2: 10
Case 3: impossible
```